NEWS RELEASE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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FOR RELEASE: WEDNESDAY PM's
March 11, 1964

RELEASE NO: 64-49

USE: EXPLORER 20 SATELLITE

NASA TO LAUNCH IONOSPHERE EXPLORER SATELLITE

The National Aeronautics and Space Administration will launch, no earlier than March 13, a 97-pound ionosphere monitoring satellite designed to explore irregularities in the Earth's ionosphere.

The Ionosphere Explorer will be launched into a circular, near-polar, 620-mile high orbit by a four-stage Scout rocket from the Pacific Missile Range, Point Arguello, Calif.

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(NASA-News-Release-64-49) NASA TO LAUNCH IONOSPHERE EXPLORER SATELLITE (NASA) 21 p N76-71847

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It will collect and transmit information on the structure of the upper ionosphere -- the layer of ionized gases that surrounds the Earth and acts as an electrified mirror for long-range radio communications.

The satellite, nicknamed "Topsi" by project people, is another important step in NASA's Ionosphere Program -- begun in 1958 to use sounding rockets and satellites to probe mysteries of the ionosphere not easily observable from the Earth.

To date, three satellites -- Explorer VIII, the U.S./United Kingdom Ariel I, and the Canadian-built Alouette I -- and a number of sounding rocket flights have pioneered topside ionosphere studies.

The Ionosphere Explorer is expected to provide information which will have both scientific and practical applications. Scientists expect to obtain a fuller understanding of the F-2 region of the ionosphere. Communications engineers will use this information in continuing studies of the mechanics of long-range radio wave transmissions and the cause of periodic blackouts.

The Ionosphere Explorer satellite program is part of the scientific space exploration program of NASA's Office of Space Science and Applications. Project Management is assigned to the NASA Goddard Space Flight Center, Greenbelt, Md. The primary experimenter is the National Bureau of Standards' Central Radio Propagation Laboratory, Boulder, Colo., an agency of the U.S. Department of Commerce.

The satellite was designed and built by the Airborne Instruments Laboratory of Cutler-Hammer, Inc., Deer Park, N.Y. An ion mass-spectrometer experiment was contributed by scientists at University College, London, England.

Satellite Structure

The 97-pound satellite is conical, shaped something like a bottom-heavy duckpin. The main section is 26 inches in diameter and 32½ inches high. Mounted at the top is a ball-shaped ion mass-spectrometer four inches in diameter. This mass-spectrometer is at the end of a 10-inch tapered boom, giving the satellite an overall length of 46½ inches. Power is provided by nickel-cadmium storage batteries which are supplied with electricity from 2,400 solar cells mounted around the side of the satellite.

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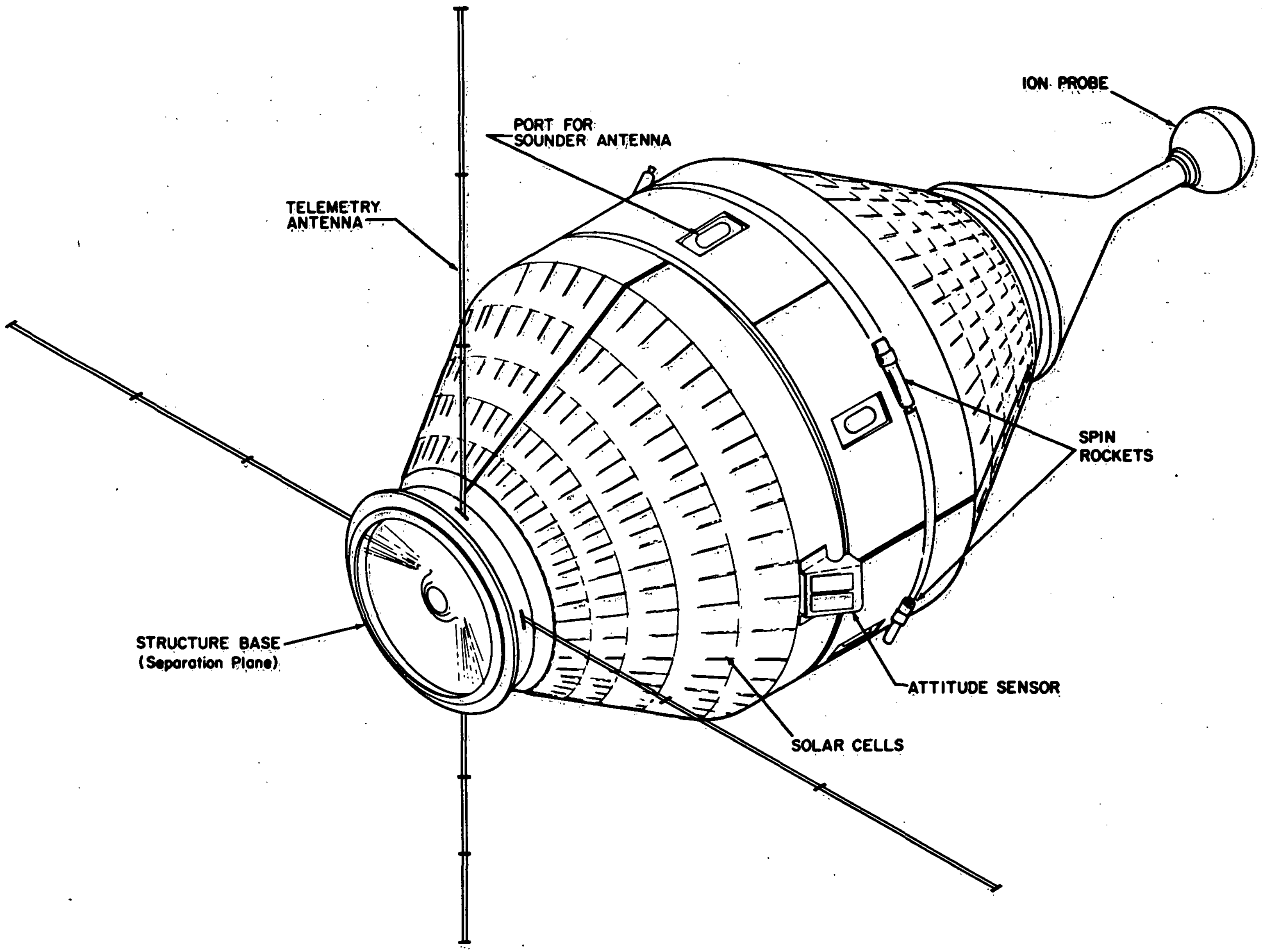


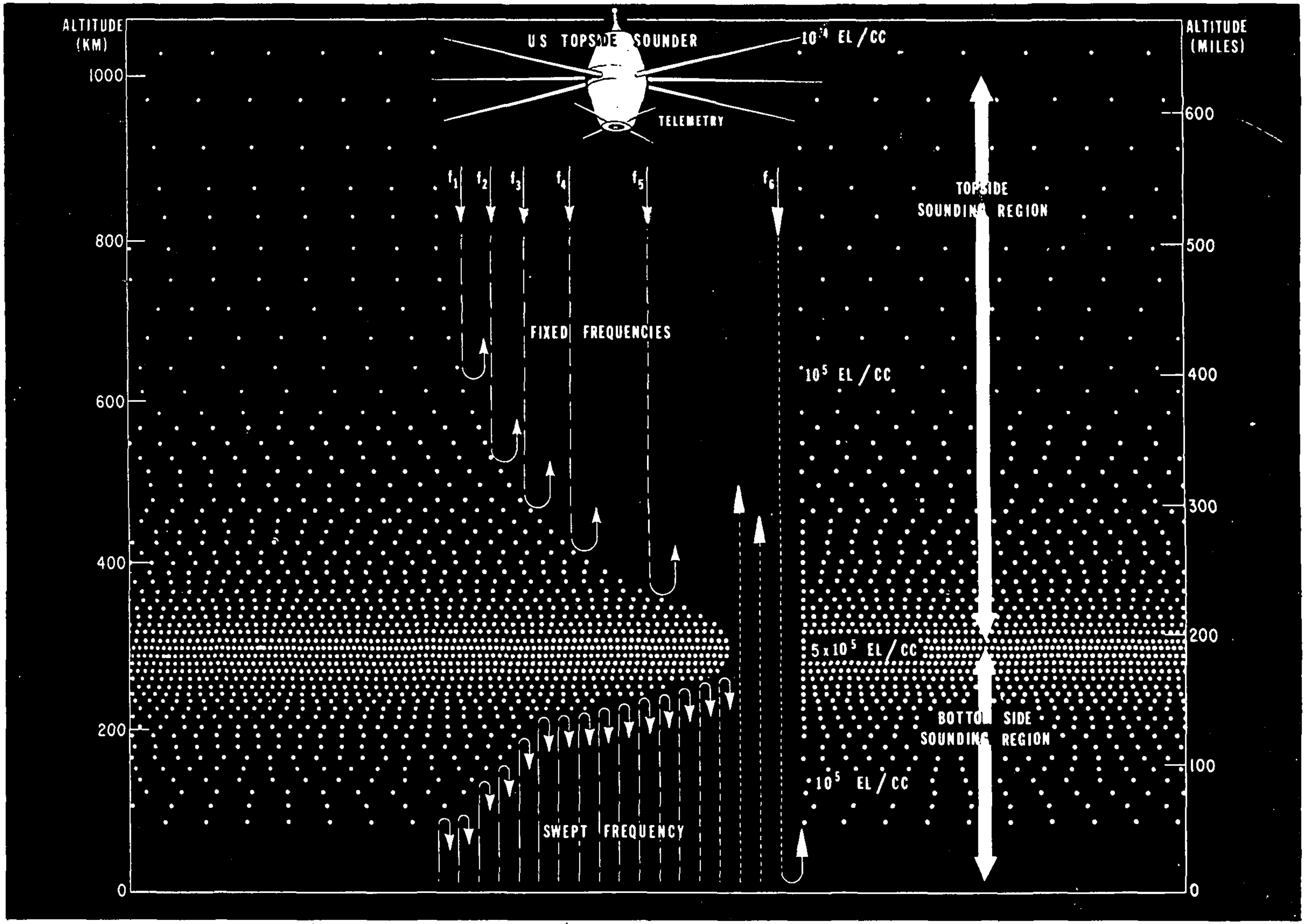
IONOSPHERE EXPLORER SATELLITE
(Fixed Frequency Topside Sounder)

Protruding from the 26-inch diameter midsection are three sets of long sounding antennas or dipoles. One set measures 122 feet from tip to tip and two sets are 62 feet across. The antennas will be extended after the satellite is in orbit. They will transmit the soundings for the primary experiment on board.

Orbit

The satellite will be launched into a circular orbit angled at 80-degrees with the Earth's equator. Separation from the Scout's fourth stage will occur about 55 minutes after lift off and about 1,500 miles southeast of the Cape of Good Hope moving northward over the Indian Ocean. The satellite will complete one full orbit about every hour and 45 minutes.

The near-polar orbit was selected to obtain ionosphere measurements at a number of stations, but concentrating on those located along the 75-degrees west meridian from the Arctic to the near Antarctic. A full cycle of daylight and seasonal variations in the upper ionosphere can be measured by each of the stations. Lifetime of the satellite is expected to be one year although three months of data will fulfill most of the desired objectives.



IONOSPHERE EXPLORER SATELLITE
ELECTRON DENSITY SOUNDING TECHNIQUE

Scientific Objectives

The satellite is a self-sufficient space platform equipped with six radar sets, a two-way communications system, a tracking beacon and a solar power system. Its primary job will be to take radio "soundings" of the upper ionosphere at six fixed frequencies. This technique is similar to that used by a world-wide network of ground ionosphere sounding stations which obtain data on the lower regions or bottomside of the ionosphere. Low-frequency radar signals are transmitted at specific intervals. These signals are reflected or "bounced back" when they reach certain levels of electron density in the ionosphere.

Feasibility of the sounding technique used by the satellite was proved by two sounding rocket flights which carried simplified Ionosphere Explorer instruments into the upper ionosphere. These experiments were conducted by the Central Radio Laboratory from the NASA Wallops Island, Va., launch site June 24 and Oct. 13, 1961.

In orbit, the Ionosphere Explorer will make a sounding with each of its six frequencies every one-tenth of a second. Signals will reflect back as various electron density levels are reached. Because a complete sounding can be performed in a brief period during less than one mile of forward motion by the satellite, an

individual sounding is accomplished over an essentially fixed location.

The ion mass-spectrometer will gather data on ion concentration and temperature in the immediate vicinity of the satellite's orbit. This information will be correlated with the sounding information.

A secondary mission objective is to obtain readings of cosmic noise, using the same frequencies employed for the sounding experiment. Cosmic noise is radio noise coming from sources outside the solar system.

Electron measurements over all geomagnetic latitudes and the full daily cycle will provide information on: (1) ionization diffusion in the F-2 region; (2) horizontal movements or irregularities in electron distribution in this region; (3) fluctuations caused by tidal movement, and (4) the mechanism or mechanisms which produce ionospheric storms.

Scientists hope that the information will help explain such events as the "Spread-F Phenomenon" which consists of large patches of irregularities in the F-2 region frequently observed at night in the polar and equatorial regions. Other mysteries to be explored include "radio-wave ducting," a process in which radio energy is guided along the Earth's magnetic field;

the relation of density formations with magnetic disturbances; and the degree of "connectedness" in the F-2 region between the northern and southern hemispheres.

The sounding technique used by the Ionosphere Explorer is complementary to that used by the Canadian-built Alouette ionosphere satellite launched by NASA Sept. 29, 1962. However, emphasis and instrumentation between the two are different.

Alouette was designed by the Canadian Defence Research Telecommunications Establishment primarily to investigate in detail the vertical distribution of electron densities. Its sounders employ a swept frequency technique ranging from 0.5 to 12 megacycles. The sounding cycle takes 18 seconds during which time Alouette travels about 60 miles.

While the vertical readings are outstanding -- and Alouette has sent more than 100,000 readings or ionograms since it was orbited -- the horizontal profiles it obtains do not give a detailed picture of the horizontal irregularities. The Ionosphere Explorer, using its fixed frequency technique and rapid individual readings, will do this job.

Scout Launch Vehicle

Scout is a multi-stage launch vehicle using four solid propellant rocket motors capable of carrying payloads of varying sizes on orbital, space probe or reentry missions. Scout is 72 feet long and weighs 20 tons at lift-off.

Scout was developed by NASA's Langley Research Center, Hampton, Va. It is manufactured by Ling-Temco-Vought, Inc., Dallas, Tex.

The four motors are interlocked with transition sections which contain guidance, control ignition, instrumentation systems, separation mechanisms, and the spin motors required to orient the fourth stage. Guidance is provided by an autopilot and control achieved by a combination of aerodynamic surfaces, jet vanes, and hydrogen peroxide jets.

Scout is capable of placing a 240-pound payload into a 300-mile orbit or of carrying a 100-pound scientific package some 7,000 miles away from Earth.

On its last mission, Scout successfully launched Explorer XIX, a 12-foot diameter inflatable sphere, on Dec. 19, 1963,

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from Point Arguello, Pacific Missile Range, Calif. On that flight Scout used a new fourth stage motor, the X-258, which was specially instrumented to monitor flight performance and flight environment. For this launch, however, the fourth stage will be the X-248 motor which has flown a number of times before.

Scout stages include the following motors:

First stage:	Algol IIA (Aerojet Jupiter Senior) - 105,000 pounds thrust burning 68 seconds.
Second stage:	Castor (Thiokol Improved Sergeant) - 55,000 pounds thrust burning 40 seconds.
Third stage:	Antares (ABL S-259) - 15,000 pounds thrust burning 33 seconds.
Fourth stage:	Altair (ABL X-248) - 3,100 pounds thrust burning 41 seconds.

Flight Sequence

The satellite, about 55 minutes after launch, will separate from the fourth stage and should be in its desired 600-mile-plus orbit. It will be moving northward over the Southern Indian Ocean, having passed over the Antarctic.

Extension of the antennas then will be initiated. Before the antennas are extended to 12 feet, two tiny de-spin rockets mounted on the satellite will be fired to reduce the satellite spin rate to a safe level of about 16 rpm. This is to prevent a possible coning motion of the satellite which could damage the sounding antennas.

Deployment of the antennas is scheduled to take about 20 minutes. The satellite will lose virtually all its spin, because the long antennas will greatly increase the moment of inertia. Once the antennas are extended, another pair of spin rockets will be ignited to increase the satellite spin to the desired in-orbit rate of 2.3 revolutions per minute.

Tracking and Data Acquisition

Data transmitted by the Ionosphere Explorer will be acquired by ten stations already being operated by the United States, Canada or the United Kingdom. Each is capable of acquiring data from the satellite over an area equivalent to that of the contentinental United States.

The stations are separated into three categories, by type of data desired:

Ionosphere Explorer Meridional Stations (75 degrees West Meridian)

Resolute Bay, Northwest Territories, Canada

St. Johns, Newfoundland

East Grand Forks, Minn.

Ft. Myers, Fla.

Quito, Ecuador

Santiago, Chile

South Atlantic (Special United Kingdom Station)

College, Alaska

Northern Latitude Stations (Primary interest to Canada)

Resolute Bay, Northwest Territories

St. Johns, Newfoundland

College, Alaska

Special Stations (Primary interest to the United Kingdom)

Winkfield, England

Singapore

South Atlantic

Information received at these stations will be recorded on magnetic tape and converted to ionograms on photographic film.

Primary responsibility for processing and reduction of data is charged to the National Bureau of Standards' Central Radio Propagation Laboratory in Boulder, Colo. Selective processing of cosmic noise and ionogram data will be accomplished by Goddard Space Flight Center. Limited data processing will be done by Canadian and United Kingdom agencies.

Ionosphere Explorer Team

NASA's Office of Space Science and Applications has overall responsibility for the Ionosphere Explorer program and project management is at the Goddard Space Flight Center.

Primary experimenter is the National Bureau of Standards' Central Radio Propagation Laboratory, Boulder, Colo., of the U.S. Department of Commerce. The ion mass-spectrometer was provided by the University College of London, England.

Design and construction of the satellite was done by the Airborne Instruments Laboratory of Cutler-Hammer, Inc., Deer Park, N.Y., under contract to the Goddard Space Flight Center.

The Scout launch vehicle is managed by the NASA Langley Research Center, Hampton, Va. Scout prime contractor is Ling-Temco-Vought, Dallas, Texas.

Canada and Great Britain will cooperate in obtaining data from the Ionosphere Explorer at special stations located in Northern Canada, the Far East and the South Atlantic Ocean. These will supplement the regular satellite tracking stations operated by the Goddard Space Flight Center as part of the STADAN network.

Logistic and launch support services at Point Arguello are provided by the Goddard Launch Operations group and the Pacific Launch Operations Office.

The Scout launching site at Point Arguello is operated jointly by NASA and the Department of Defense. Scout launchings are accomplished by the Air Force's 6595th Aerospace Test Wing in cooperation with NASA.

Key officials responsible for the Ionosphere Explorer satellite and its experiments are:

NASA Headquarters

Dr. Homer E. Newell, Associate Administrator for Space Science and Applications

Dr. John E. Naugle, Director, Geophysics and Astronomy Programs Division

M. J. Aucremanne, Ionosphere Explorer Program Manager

Goddard Space Flight Center

Dr. Harry J. Goett, Director

Dr. John W. Townsend, Jr., Associate Director, Office of Space Science and Satellite Applications

John E. Jackson, Project Manager and Project Scientist

E. Dale Nelsen, Assistant Project Manager

Robert H. Gray, Manager, Goddard Launch Operations

Joseph B. Schwartz, Associate Manager, Goddard Launch Operations (PMR)

J. M. Bridger, Scout Rocket Coordinator

Langley Research Center

Eugene D. Schult, Scout Project Manager

Central Radio Propagation Laboratory (National Bureau of Standards)

Robert W. Knecht, Project Manager

W. Calvert, Project Leader

University College, London, England

Dr. R. L. R. Boyd

Dr. A. P. Willmore

FACT SHEET

IONOSPHERE EXPLORER SATELLITE

SPACECRAFT

Weight:	About 97 pounds plus 13 pounds for the separation mechanism.
Shape:	Two truncated cones attached base to base.
Size:	Diameter, 26 inches; length, 32.5 inches; spherical probe 4 inches in diameter mounted on tapered boom at one end resulting in over-all length of 46.5 inches.

LAUNCH PHASE

Launch site:	Point Arguello, Pacific Missile Range.
Launch rocket:	Four-stage, solid-fuel Scout.
Launch Azimuth:	169-degrees.
Orbit:	Circular, 80-degree polar orbit about 620 miles.
Orbital period:	105 minutes.
Satellite life:	12 months with automatic shut-off.

ELECTRICAL POWER

Required:	140 watt-hours, to provide four hours of data acquisition per day.
Supply:	2,400 P/N solar cells mounted around sides of spacecraft and nickel-cadmium storage batteries (23 size F cells).

SOUNDING EXPERIMENT (Central Radio Propagation Laboratory)

Sounding transmitters:	Six 8- to 45-watt transmitters pulsed on in sequence.
Sounding frequencies:	1.5 Mc, 2.0 Mc, 2.85 Mc, 3.72 Mc, 5.47 Mc, and 7.22 Mc.
Sounding antennas:	Two sets of dipoles, 62 feet tip-to-tip; one set of dipoles, 122 feet tip-to-tip.
RF pulse spacing:	Every 0.1 seconds.
RF pulse sequence:	Six pulses (one for each sounding frequency); during the seventh 15-millisecond interval, a calibration pulse and ion probe data are transmitted.

ION MASS SPECTROMETER EXPERIMENT (University College of London, England)

Sensor:	Charged spherical probe surrounded by negatively charged grid.
Applied charges:	Sawtooth, -2-to+10-volt, 500-cps sine wave; 3.2-kc sine wave.
Measures:	Positive ion current.

COMMAND SYSTEM — Two AVCO command receivers and a seven-tone decoder; 10 basic instructions can be given to the spacecraft.

TRACKING — Beacon transmitter 136.68 Mc.

TELEMETRY

Spacecraft telemetry:	Beacon transmitter power increased to 0.25-watt PM, on command, to transmit housekeeping data.

Experiment telemetry:	2-watt, 136.350-Mc FM transmitter telemeters sounder, ion mass spectrometer data on command.
Data acquisition:	10-minute readout in real time on command only.

TELEMETRY AND TRACKING STATIONS

Station	
St. Johns, Nfld.	STADAN*
East Grand Forks, Minn.	STADAN
Ft. Myers, Fla.	STADAN
Quito, Ecuador	STADAN
Santiago, Chile	STADAN
College, Alaska	STADAN
Winkfield, England	STADAN
Resolute Bay, N.W.T.	Special (Canada)
South Atlantic	Special (UK)
Singapore	Special (UK)

*STADAN (Space Tracking and Data Acquisition Network) stations are operated by the Goddard Space Flight Center.

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